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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/998,993	11/15/2001	Michael Turner	M-12396 US	9456

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EXAMINER

MALDONADO, JULIO J

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 10/16/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/998,993

Applicant(s)

TURNER ET AL.

Examiner

Julio J. Maldonado

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 July 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 11-25 is/are allowed.
- 6) ☒ Claim(s) 1-3 and 6-10 is/are rejected.
- 7) ☒ Claim(s) 4 and 5 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. The addition of claims 21-25 is acknowledged.
2. Thus, claims 1-25 are pending in this application.

Claim Rejections - 35 USC § 102

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-3, 6 and 8 are rejected under 35 U.S.C. 102(e) as being anticipated by Jost et al. (U.S. 6,596,641 B1).

In reference to claim 1, Jost et al. (Figs.1-7) in a related deposition process teach a method for depositing a doped silicon dioxide layer (20, 22, 24) onto a wafer (12) including introducing a dopant precursor gas having a dopant precursor gas flow rate and a silicon-containing gas having a silicon-containing gas flow rate into a plasma, wherein a ratio of the dopant precursor gas flow rate to the silicon-containing gas flow rate has an initial value; increasing the ratio from the initial value to a final value during an initial period; and maintaining the ratio at the final value during a final period, wherein during the initial period and the final period the dopant precursor gas and the silicon-containing precursor gas react in the plasma to form the doped silicon dioxide layer (20, 22, 24) on the wafer (12) (column 4, line 1 – column 7, line 3).

In reference to claim 2, Jost et al. teach wherein a portion of the doped silicon dioxide layer deposited during the initial period has about the same dopant

concentration as a portion of the doped silicon dioxide layer deposited during the final period column 6, lines 15 – 22, and column 7, lines 1 – 3).

In reference to claim 3, Jost et al. teach etching one or more contact holes through the doped silicon dioxide layer, wherein the one or more contact holes have straight sidewalls (Jost et al., Fig.6).

In reference to claim 6, Jost et al. teach wherein increasing the ratio from the initial value to the final value comprises dividing the initial period into a number of increments; and increasing the ratio by an intermediate value at each increment (column 4, lines 50 – 64 and column 6, line 15 – column 7, line 3).

In reference to claim 8, Jost et al. teach preheating the wafer to a preheat temperature (column 5, lines 18 – 60).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 7, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jost et al. ('641 B1).

Jost et al. (Figs.1-7) in a related deposition process teach a method for depositing a doped silicon dioxide layer (20, 22, 24) onto a wafer (12) including introducing a dopant precursor gas having a dopant precursor gas flow rate and a silicon-containing gas having a silicon-containing gas flow rate into a plasma, wherein a ratio of the

dopant precursor gas flow rate to the silicon-containing gas flow rate has an initial value; increasing the ratio from the initial value to a final value during an initial period; and maintaining the ratio at the final value during a final period, wherein during the initial period and the final period the dopant precursor gas and the silicon-containing precursor gas react in the plasma to form the doped silicon dioxide layer (20, 22, 24) on the wafer (12), and wherein the wafer is preheated at a temperature of about 530°C (column 4, line 1 – column 7, line 3).

However, Jost et al. fail to teach the steps of providing a dopant precursor gas comprising phosphine (PH_3) or diborane (B_2H_6) and a silicon-containing precursor gas comprising silane (SiH_4). However, Lin et al. (Figs.3-7) in a related method to deposit a layer of doped silicon dioxide (44) teach the steps of providing a dopant precursor gas comprising phosphine (PH_3) and diborane (B_2H_6) and a silicon-containing precursor gas comprising silane (SiH_4); and applying plasma conditions on the precursor gases (column 8, lines 18-39 and column 9, lines 10-39). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use phosphine or diborane as precursor gases under plasma conditions as taught by Lin et al. in the silicon dioxide formation method of Jost et al., since it would avoid voids in the oxide layer during an etching process (column 5, lines 51-57).

The combined teachings of Jost et al. and Lin et al. fail to teach wherein the preheat temperature is 350°C, the initial value of the ratio is about 0.49, and the final value of the ratio is about 0.77. However, the selection of the claimed ranges is obvious because it is a matter of determining optimum process condition by routine

experimentation with a limited number of species. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to enable using the above-mentioned ranges to arrive at the claimed invention.

Allowable Subject Matter

6. Claims 4 and 5 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

7. Claims 11-25 are allowed.

8. The following is a statement of reasons for the indication of allowable subject matter:

Jost et al. (Figs.1-7) in a related deposition process teach a method for depositing a doped silicon dioxide layer (20, 22, 24) onto a wafer (12) including introducing a dopant precursor gas having a dopant precursor gas flow rate and a silicon-containing gas having a silicon-containing gas flow rate into a plasma, wherein a ratio of the dopant precursor gas flow rate to the silicon-containing gas flow rate has an initial value; increasing the ratio from the initial value to a final value during an initial period; and maintaining the ratio at the final value during a final period, wherein during the initial period and the final period the dopant precursor gas and the silicon-containing precursor gas react in the plasma to form the doped silicon dioxide layer (20, 22, 24) on the wafer (12), and wherein the wafer is preheated at a temperature of about 530°C (column 4, line 1 – column 7, line 3).

However, Jost et al. fail to teach adjusting a ratio of the dopant precursor gas flow rate and the silicon-containing gas flow rate as a function of wafer temperature; determining a duration of the initial period by measuring a temperature of the wafer during a test deposition of a doped silicon dioxide layer, wherein the duration is the time required for the temperature to reach an essentially constant value; measuring a concentration of dopant incorporated into a portion of a silicon dioxide layer as a function of the ratio for a first series of test depositions performed at a constant temperature; repeating the measurement of dopant concentration for a second series of test depositions performed at a different constant temperature; and measuring a temperature profile of the wafer during a third test deposition wherein the temperature is not held constant, whereby the initial value of the ratio is determined.

Response to Arguments

9. Applicant's arguments with respect to claims 1-25 have been considered but are moot in view of the new ground(s) of rejection.


Conclusion

10. Papers related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is **(703) 305-3432**. The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Julio J. Maldonado** at **(703) 306-0098** and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via julio.maldonado@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 308-0956**.


JMR
10/2/03


George Fourson
Primary Examiner